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FLUKE INFECTIONS AND THE DESTRUCTION OF THE INTERMEDIATE HOST *

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Two articles have recently appeared which demand more than passing notice by the biologist and fish culturist. An editorial in the Journal of the American Medical Association (1921) calls attention to methods proposed by Chandler (1920) for the purpose of exterminating certain dangerous flukes by eradicating their intermediate host (namely, mollusks), and strongly recommends the prophylaxis suggested. In view of the wide circulation of this medical journal, and of the harmful results that would result from the general application of the remedies suggested, it seems necessary to draw attention to the general relationships of fresh water animals and the consequences of interfering in too large a degree with the normal activities of a biota.

It is realized that in certain localities fluke infection does a vast amount of harm to both man and domestic animals, and methods for the elimination of this disease are to be welcomed by all people interested in the welfare of the human race. The remedy suggested by Chandler, however, is so far-reaching in its results, in directions probably not considered by the author, that it calls for comment and vigorous protest by those interested in the conservation of our aquatic resources.

Two classes of water bodies are considered by Chandler; one the small swale or pool, filled with water during the wet season (winter and spring of the north), and dry or but partly filled with water in the dry season (summer and fall of the north). As these pools are more or less temporary and contain no life of great biologic or economic importance, the eradication of mollusks and other forms would be clearly desirable for the control of the fluke, as well as for the destruction of the malarial-bearing mosquito larvae, especially in endemic areas. But many of the species of mollusks harboring intermediate stages of flukes inhabit running streams, lakes, and large ponds, and in these cases to apply the remedy suggested would not only affect the snails in question, but also other associated animals, including fish.

In his paper Chandler remarks that "Experiments by the writer, as well as by others, show that copper, one part per million, is not injurious, *at least within* 48 *hours,* to annelids, crustaceans, or aquatic insect larvae. Of vertabrate animals, *fish are highly susceptible, various species being affected by* 1 *part of copper sulphate in from* 500,000 *to* 10,000,000 *parts of water*. . . . It is evident, therefore, that copper salts in high dilution have a selective effect on various organisms, being particularly destructive to single-celled organisms, certain molluscs, *and fishes*" (italics are the writer's). The effect of copper salts on the fish fauna of a stream, if this method of eradication were to be carried out on a large scale, may well be imagined.

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During the past ten years or more, attention has been largely directed to the question of river and stream pollution by sewage and chemicals, and biologists and sanitary engineers have written extensively on the subject (see Ward, Forbes and Richardson, Shelford, Baker). Sewage, highly concentrated, has been shown to be very injurious to mollusks and other animals, and to eradicate them in a few years (Baker, 1920). In the Allegheny River in Pennsylvania, mine water containing acids has effectively destroyed all forms of animal and vegetable life in sections of the river (Ortmann, 1909). The use of copper salts in sufficient strength to eradicate all possible hosts of flukes in streams and rivers would in a short time destroy fish as well as the food upon which they subsist.

The general interrelationships of the inhabitants of water bodies are not always well understood by either biologists or medical practioners. A noted student of fresh water biology has aptly said that a body of water is a microcosm in which all of the activities of life go on uninterrupted, quite independent of the land, which, for practical purposes, might be eliminated without seriously affecting the water population. All of the inhabitants of these microcosms are interdependent; a destruction of one groups affects all. Animal life is dependent, in the final analysis, on vegetable life, the great majority of invertebrate animals being herbivorous in food habits (over 99 per cent. are herbivorous or detritus eaters; see Baker, 1918:205). Copper salts are especially toxic to all forms of algae (one of the commonest foods of invertebrate animals) and the destruction of mollusks as hosts of flukes would also destroy the algae on which many groups of animals feed—amphipods, chironomid larvae, obligochaete worms, ephemerid nymphs, etc. (Baker, 1918:205). This in turn would deprive the carnivorous forms of their food and the result would be the complete elimination of the fauna and flora from the body of water treated.

Many of the molluscan hosts live in the smaller streams, although all genera of hosts live also in the largest lakes and rivers, and the question may be raised as to whether the life of these small streams is of any consequence, economically. Studies of fish culturists and biologists have shown that these small streams are of the greatest value, providing favorable spawning places for adult fish and feeding places for the young which later migrate to the larger bodies of water. The smaller species of fish which are not of any direct economic importance are of indirect value in furnishing food for the larger carnivorous food and game fishes, and their destruction would result in great harm to the fresh water fisheries of our country. Copper salts would also be inimical to the river mussels (from which pearl buttons are made), both in the adult stage and, especially, in the glochidial or embryonic stage, during which time they are completely dependent on fish for development (see Coker, et al., 1921).

In conclusion it may be pointed out that the suggested control of such snails as are intermediate hosts of certain species of flukes inimical to man and the domestic animals, while applicable to small bodies of water not connected directly with running streams or large lakes, is absolutely impracticable for running streams and larger bodies of water. To successfully eradicate all possible intermediate hosts of flukes would necessitate the pollution of water bodies to such an extent that most forms of life would be ultimately killed; in comparison with this toxic agent, when used effectively, our present stream pollution by sewage would sink into insignificance.

Chandler's experiments are of the highest interest and value and their practical application in special places, especially in endemic areas, will doubtless be effective, and desirable. It must be pointed out, however, that the methods suggested could not be used on a large scale without seriously affecting all aquatic resources and several important industries dependent upon fresh water life for raw material.

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